The conservation of the Giant Gippsland Earthworm *Megascolides australis* in relation to its distribution in the landscape

Beverley D Van Praagh[1], Alan L Yen[2] and Neville Rosengren[3]

[1] 25 Jacaranda Place, Craigieburn, Victoria. 3064.
[2] Primary Industries Research Victoria, Department of Primary Industries, 621 Burwood Highway, Knoxfield, Victoria 3156. alan.yen@dpi.vic.gov.au
[3] Department of Physical Sciences and Engineering, La Trobe University, Bendigo, Victoria.

Abstract

It is difficult to identify the main factors that determine the distribution of the Giant Gippsland Earthworm because of the completely subterranean nature of this species. Past emphasis has involved research on soil factors (such as texture and chemical composition) and topography (slope, aspect, proximity to water). More recent research indicates that its distribution results from a combination of many interrelated factors, most importantly, underground hydrological processes. The pre-European settlement environment for the Giant Gippsland Earthworm was predominantly tall wet forest, but it has survived in pockets of exotic pastures and riparian zones. However, some of the revegetation programmes established to address degraded habitat may ultimately be detrimental to surviving populations of the Giant Gippsland Earthworm. (*The Victorian Naturalist*, **124** (4), 2007, 249-253)

Introduction

The Giant Gippsland Earthworm *Megascolides australis* is listed as 'Vulnerable' under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and 'Threatened' under the Victorian *Flora and Fauna Guarantee Act 1988*. The development of conservation strategies for this species has not been straightforward because of its totally subterranean nature and the difficulty involved in identifying its habitat without detailed surveys that involve destruction of habitat and death of individual worms.

The subterranean nature of *M. australis* and its presence in landscapes without native vegetation often results in its neglect from consideration in planning applications. Conservation decisions in the terrestrial environment are based very much on the presence of vegetation and its condition (relative to its supposed condition at the time of European settlement). Vegetation is used as a surrogate for many threatened species, and improvement in vegetation condition is often viewed as part of the solution required to conserve threatened species. Problems arise when a threatened species such as *M. australis* is not necessarily associated with native vegetation.

Distribution of the Giant Gippsland Earthworm in relation to altered landscape

Megascolides australis has co-existed with agricultural land use since European settlement of South Gippsland in the 1870s, and has survived major changes to its habitat, mostly associated with agricultural development and expansion. However, the overall effects of these habitat changes on *M. australis* populations and their distribution are not clearly understood. *Megascolides australis* is confined almost entirely to privately owned agricultural land with only small pockets of remnant vegetation remaining along some stream banks, gullies and road sides. Mt Worth State Park is the only area within the species' range that has remnant vegetation and *M. australis*; it is located at the eastern extreme of the range of this species.

The reduction in *M. australis* range has generally been attributed to post-European settlement tree clearing and subsequent agriculture practices. Within this present agricultural landscape, *M. australis* is generally associated with stream banks, wet gullies/soaks, and south facing hillslopes with terracettes. Its distribution appears to be primarily correlated with hydrological conditions that remain to be identified.

There is no historical information available on the distribution of *M. australis* at the time of European settlement. It is thought that before European settlement, the area was covered by wet forest with continuous canopy cover, but old forests were probably dominated by fewer larger trees with a more open understorey. The ground layer was more grassy and with more logs and coarse woody debris. The thick regrowth often associated with this type of wet forest was due to fires, but the area did not experience many fires, and most of the forest was thought to be mature. The lower slopes were dominated by *Eucalyptus strzeleckii* and higher slopes probably by *Eucalyptus regnans* (David Cameron and Josh Dorrough, pers. comm. 2004).

Since the 1870s, extensive forest clearing, introduction of grazing animals and the maintenance of a more-or-less continuous ground cover of sown pasture has greatly altered the surface and sub-surface hydrology. The effects of initial vegetation clearance on soil habitat would have been pronounced in the upper soil horizon where increased exposure after tree removal would have resulted in decreased moisture levels. This may have resulted in fragmentation of *M. australis* populations and local extinctions. However, the deeper soil horizon primarily occupied by *M. australis* would have been somewhat buffered from the initial changes in soil microclimate and may have experienced increase in available moisture due to the absence of large trees transpiring and removing soil moisture. *Megascolides australis* habitat would also have been reduced by the loss of topsoil over time through increased runoff (Van Praagh *et al.* 2004, 2005). Giant Gippsland Earthworms are non-selective, geophagous feeders, relying on organic matter, bacteria and fungi digested from soil passed through the gut (Van Praagh 1994). This generalised diet and their depth in the soil profile may have allowed them to cope with the change from forest to permanent pasture and in time, adapt to the changed conditions.

Past research on the factors determining distribution of the Giant Gippsland Earthworm has emphasised soil and topographical factors (slope, proximity to water) (Van Praagh *et al.* 1989; Van Praagh 1992). More recently, the distribution of *M. australis* was assessed at two locations, Jumbunna at the southern end of its distribution and Ellinbank towards the northern end of its distribution (Van Praagh *et al.* 2004, 2005). *Megascolides australis* was found in four distinct habitats at Jumbunna: minor creek and drainage lines, flat to gentle sloping alluvial terraces above present flood levels, steep south facing hillslopes with terracettes and colluvial footslopes without terracettes. The landscape features at Jumbunna that are thought to influence *M. australis* distribution are the nature and depth of the soil, slope, micro-topography and aspect of the steep hillslopes, in addition to site soil and surface hydrology. *Megascolides australis* was found in only one main habitat at Ellinbank, the lower slopes and colluvial and alluvial terrain adjacent to the stream channels and just above the level reached by moderate flooding. This is in contrast to the four habitats for *M. australis* at Jumbunna and may be due to differences in geomorphology between the two sites. The slopes at Ellinbank are morphologically simple and lack the distinct segmentation observed at Jumbunna in the steeper, higher terrain of the Strzelecki Ranges. There are no major differences in slope form between the upper and lower slopes in the Ellinbank study area, and the ridge crests are broad and gently rounded. The slopes also lack the distinctive tread and riser terracing ('sheep tracks'), that is a characteristic of the steeper terrain developed on sedimentary rocks, and soils were more coherent and with lower moisture content than the terraced features. This morphologically simpler landscape appears to provide fewer areas of suitable *M. australis* habitat with the appropriate hydrological parameters. Whether these features are characteristic of the broader geomorphology of the basalt-derived soil landscapes in the north of the species' range requires further investigation. This comparison illustrates the complexity of factors that determine distribution of *M. australis*.

Current thoughts on revegetation and the Giant Gippsland Earthworm

Revegetation programs are widely advocated for a variety of reasons including to control for soil erosion, to reduce waterlogging and to protect water quality of streams, and to provide shade and shelter for stock (Thompson *et al.* 2003; G. Trease pers.com. 2005). Increasing the nature conservation value of an area may also be included, and for the past 10 years revegetation of *M. australis* habitat has been one of the key recommendations for the conservation of *M. australis* on private land (e.g. Van Praagh 1991; Taylor *et al.* 1997). Plantings are used in a variety of situations including riparian strips, gullies, landslips, windbreaks and as linkages between remnant vegetation. The current recommendations for revegetation in the south Gippsland region include approximately 2000 plants per ha with a species composition of 15-25% trees, 40% mid-storey and the remainder understorey and grasses. However, the proportion of tree species in the area has been as high as 40% (G. Trease pers. com. 2005).

Results of research into distribution of *M. australis* at Mt Worth State Park, the only area within the species' range to support remnant vegetation, first brought attention to the possibility that dense revegetation of habitat occupied by *M. australis* may not necessarily be of benefit to the species and may indeed be harmful (Van Praagh and Hinkley 1999). During this survey work, populations of *M. australis* were found to occur predominantly in open pastured areas within the Park and on clay management vehicle tracks, and distribution was limited to the edges of more densely vegetated areas.

It is possible that major alteration to soil hydrology in the current landscape, such as extensive tree planting, may pose a threat to populations of *M. australis*. These plantings may impact on the sub-surface area available for *M. australis* habitat by filling potential occupation space with tree roots and woody debris. There is also the likely impact on the water table, whereby increased transpiration rates will lower water tables, leading to drying of soils in potential worm habitat on the lower slopes, colluvial slopes and floodplains, thereby decreasing suitable habitat for *M. australis*. Whilst not all factors influencing the distribution of *M. australis* are known, one of the most important is related to soil hydrological factors. Active populations are always found in moist soils and the burrows are very wet, often with a significant amount of free water flow in them. For example, where *M. australis* occurs on the steep mid to lower slopes of south facing steeper hillslopes, they are usually associated with areas of groundwater seepage zones that can be identified by the presence of terracettes. The presence of terracettes indicate that the land surface is wetter than the surrounding area, which may be important in sustaining conditions required for *M. australis* survival. The terracettes provide increased soil moisture through temporary pondage during run-off, thus allowing retention and recharge of soil moisture.

Future research needs for the conservation of *M. australis*

At present the effect of revegetation on *M. australis* habitats is unknown and remains speculative. However, the absence of *M. australis* from heavily vegetated sites at Jumbunna (Van Praagh *et al.* 2004), Ellinbank Research Station (Van Praagh *et al.* 2005) and their presence in pasture adjacent to native forest and clay service vehicle tracks at Mt Worth State Park (Van Praagh and Hinkley 1999) suggest that recommendations to revegetate *M. australis* habitat for its conservation need reassessing. In a recent report on Best Management Practices for riparian habitats in Gippsland dairy regions, Thompson *et al.* (2003) found that their suggested index of riparian condition indicated that an excellent condition score required vegetation 30 metres wide on either side of a stream. Whilst the broader benefits of revegetation of riparian zones are acknowledged, the effects of dense replanting of areas occupied by *M. australis* require investigation. Very few stream areas in South Gippsland currently have 30 metres of vegetation on either side, and if revegetation projects aim to recreate buffers of this width, then the effects on *M. australis* have to be considered. Despite the preliminary nature of these findings, given the scale of revegetation in the region, and in particular the often very dense planting of riparian *M. australis* habitat, revegetation may represent one of the most important potential impacts on populations of *M. australis*.

With the increasing rate of land use changes within the distributional range of the Giant Gippsland Earthworm, there is an urgent need to address this situation. Two immediate research requirements to assist its conservation can be identified. First, a program to determine the impacts of revegetation on factors such as soil moisture, hydrological patterns and water table levels, and how these might impact on populations of *M. australis*. This is not a criticism of revegetation as a form of habitat restoration, but in the case of *M. australis* the appropriate levels and methods of revegetation need to be assessed. Second, the inappropriate use of native vegetation cover as a surrogate for habitat for threatened species such as *M. australis* needs to be addressed. Research is required to identify high priority Giant Gippsland Earthworm habitat using non-destructive techniques, such as digital elevation modelling, followed by ground truthing. Without these, the land use changes in South Gippsland may result in a rapid destruction of the remaining *M. australis* populations.

Acknowledgements
The authors wish to thank the many people who have assisted them in undertaking work on the GGE: Annette Muir, Susan Taylor, Geoff Trease, the Enbom family at Jumbunna and DPI at Ellinbank for allowing access to their properties. Some of the work undertaken was funded by the DSE/DPI ESAI.

References

Taylor S, Crosthwaite J and Backhouse G (1997) Giant Gippsland Earthworm, *Megascolides australis*. Action Statement No. 77. Department of Natural Resources and Environment.

Thompson L, Robertson A, Jansen and Davies P (2003) Identifying best management practices for riparian habitats in Gippsland dairy regions: Riparian condition and relationships with farm management. Charles Sturt University Johnstone Centre Report No. 178.

Van Praagh B (1991) Giant Gippsland Earthworm. *Land for Wildlife* Note No. 11.

Van Praagh B (1992) The ecology, distribution and conservation of the Giant Gippsland Earthworm, *Megascolides australis* McCoy 1878. *Soil Biology and Biochemistry* **24**, 1363-1367.

Van Praagh B (1994) The biology and conservation of *Megascolides australis* (McCoy 1878). (Unpublished PhD thesis, La Trobe University)

Van Praagh B and Hinkley S (1999) Distribution of the Giant Gippsland Earthworm, *Megascolides australis* McCoy within the Gippsland Regional Forest Agreement Area. (Unpublished report for the Department of Natural Resources & Environment)

Van Praagh B D, Yen AL and Lillywhite P K (1989) Further information on the Giant Gippsland Earthworm *Megascolides australis* (McCoy 1878). *The Victorian Naturalist* **106**, 197-201.

Van Praagh B D, Yen AL and Rosengren N (2004) Giant Gippsland Earthworm case study: Management of farm habitats for Earthworm conservation in South Gippsland. Part 1. Jumbunna. Report for Ecologically Sustainable Agriculture Initiative (ESAI) sub-project 05118.

Van Praagh B D, Yen AL and Rosengren N (2005) Giant Gippsland Earthworm case study: Management of farm habitats for Earthworm conservation in South Gippsland. Part 2. Ellinbank. Report for Ecologically Sustainable Agriculture Initiative (ESAI) sub-project 05118.

Received 7 June 2007; accepted 19 July 2007

Egg capsule of Giant Gippsland Earthworm *Megascolides australis*. Photograph supplied by Alan L Yen

Treeless habitat of the Giant Gippsland Earthworm: south facing terraced hillslope and creek banks above an active flood plain. Photograph by Beverley van Praagh.

Giant Gippsland Earthworm *Megascolides australis*, in situ. Photograph by Beverley van Praagh.